Space Weather Technical Forecast

Issued on Tuesday, 02 November 2021 at 13:01 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of further M-class flares. Slight chance of G1/Minor geomagnetic storms throughout the forecast period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: There are three sunspot regions on the visible disc with moderate solar activity observed over the last 24 hours. The moderate activity was a result of long duration M1.7 flare peaking around 02/0300UT from the region AR2891 (Dac/Beta), which resulted in a new halo CME. AR2887 (Hsx/Alpha) also produced a long period flare which peaked at C4.4 at 01/2158UTC and produced a CME which may glance earth on the 4th. AR2893 (Hsx/Alpha) in the northeast quadrant appears stable and benign.

The new halo CME mentioned above has yet to be modelled but is assumed to be earth directed and will be incorporated in subsequent updates when modelling results are known.

Solar Wind / Geomagnetic Activity: Solar wind parameters indicated the connection to the high speed stream from coronal hole 16. Solar wind speeds increased through the period, and are now close to 600km/s. Density was largely above average until 01/2130 UTC, peaking at 41ppcc at 01/2030UTC, before decreasing and becoming steady at average levels. Total IMF, Bt, increased to moderate levels, reaching 15nT between 01/1952UTC and 01/2007UTC, before showing a similar trend to the density and is now at weak levels. The north-south component, Bz fluctuated between peaks of +15nT and -11nT from 01/1721UTC until around midnight UTC, becoming more weakly variable since. Phi angle was variable before midnight UTC, before settling mostly positive (away from the sun). Geomagnetic activity was initially Quiet, but increased Unsettled to G1/Minor Storm from 01/2100UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured by GOES-16 remained slightly elevated but below the S1 level. The high energy electron flux (greater than 2 MeV) was mainly at background levels with the associated 24-hour electron fluence below the Active (1e8 integrated pfu) threshold, and with 2.84e6 integrated pfu recorded at 02/0000 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to remain mainly low through the next four days, but with a continuing risk of M-class flares from the two most complex regions.

Solar Wind / Geomagnetic Activity: The high speed stream from coronal hole 16 is expected to continue to influence earth on days 1 and 2. Further CMEs may glance the earth on days 2 and 3, although these are considered to be low probability. A new halo CME, associated with the M1 flare from 2891 around 02/0300UTC has yet to be modelled but is assumed to be earth directed and will be incorporated in subsequent updates when modelling results are known. Unsettled geomagnetic conditions are forecast to predominate through the next four days. There is a slight chance of Active or G1/Minor Storm intervals through the forecast period, due either to

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the high speed stream, CME effects, or combinations of these events.

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be below the S1 minor storm level, and generally decreasing towards background values. The high energy electron flux (greater than 2 MeV) is forecast to be at mainly background to moderate levels, with a slight chance of reaching sustained moderate or occasionally high levels through days 2 to 4. Corresponding 24 hour electron fluence values are expected to remain below the Active (1e8 integrated pfu) level, although a rising trend is possible through days 2 to 4.

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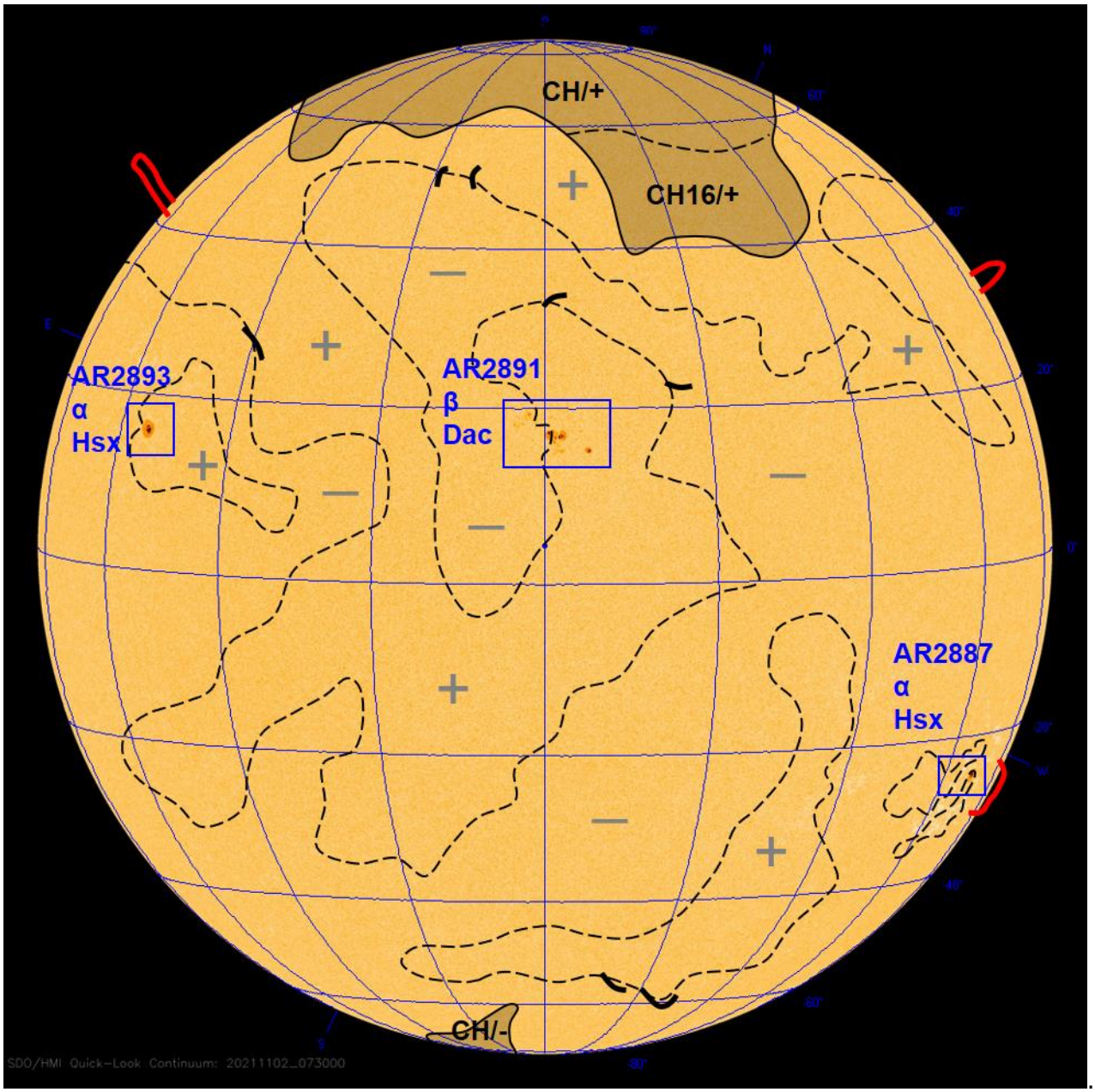
Figure 1. Solar Analysis Valid 02/0730 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The solar wind has increased to near 600km/s following connection with coronal hole 16, there is a risk of Active intervals or G1/Minor Storms on days 1 and 2.

There is also a risk that a CME which left the sun on 31st October may glance the earth later on day 2, with a risk of a further glance from a CME which left the sun on 1st November glancing earth on day 3. A new halo CME, associated with the M1 flare from 2891 around 02/0300UTC has yet to be modelled but is assumed to be earth directed and will be incorporated in subsequent updates when modelling results are known.

Generally Unsettled activity is likely through the forecast period due to a combination of the high speed stream connections and possible CME arrivals. There is a slight chance of Active intervals or G1/Minor Storms throughout the period, due to the shocks and an subsequent effects of a CME, and also due to high speed stream influence on days 1 and 2.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	20	20	20	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
31/1628	Partial	C3 flare	AR2891	490km/s	03/1200 UTC	Possible glancing blow
01/0130	Partial	M1 flare	AR2887	426km/s	Early 4th	Possible glancing blow but Low confidence

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Radio Blackouts - X-Ray Flares:

Solar activity is expected to be mainly low, with an ongoing risk of C-class flare activity and a lower chance of M-class flares. The main risk region is AR2891 (Dac/Beta), which gave a long duration M1 flare peaking around 02/0300UTC. AR2887 (Hsx/Alpha) has a history of significant flare activity and has recently produced C-class flares and CMEs as it approaches the southwest limb.

AR2893 (Hsx/Alpha) in the northeast quadrant appears to be benign with no signs of significant development.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	40	30	20	20
Very Active	R3 to R5 X Class	No	5	2	2	2

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as observed by GOES-16 is below S1/Minor storm levels. The trend has remained largely steady for the last 24 hours, with brief slight elevations in the values of the lower energy protons, most likely due to the M-class flare on 01 November. Further minor enhancements from significant flaring remain possible.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	5	5	5
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons Event (≥ 2MeV):

High energy electrons (greater than 2MeV) are currently at mainly background levels, with brief increases to moderate values, with no significant increases expected on day 1. The high speed stream from coronal hole 16 has connected at Earth, and may lead to an increase in values through days 2 to 4, perhaps reaching sustained moderate, occasionally high levels. However any increase is subject to potential CME arrivals on days 2 and 3, which may glance the Earth and lead to a disruption of the radiation belts.

Electron fluence values are forecast to remain below the Active (1e8 integrated fluence) threshold through much of the forecast period, with a rising trend possible through days 3 and 4.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	10	20	20
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

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